SECTION 15865

FILTERS

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LANL MASTER CONSTRUCTION SPECIFICATION

When editing to suit project, author shall add job-specific requirements and delete only those portions that in no way apply to the activity (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the LEM Mechanical POC.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Information within "stars" is provided as guidance to the author responsible for revising the specification. Delete information within "stars" during editing.

This specification serves as a template. The specification was prepared by an organization operating under a quality assurance program that meets the requirements of 10 CFR 830 (suitable for ML-1 through ML-4 projects). Implementation of this specification requires modification to the specification to meet project-specific requirements. Responsibility for application of this specification to meet project-specific requirements lies with the organization modifying or implementing the specification. The organization modifying the specification shall apply a graded approach to quality assurance based on the management level designation of the project. When this specification is used with nuclear facilities subject to 10 CFR 830, modification to this specification must be performed by an individual or organization operating under a quality assurance program that meets the requirements of that CFR.

This specification serves as a template for procurement of filters at LANL. There is a list of filters that are pre-approved for use in LANL. The performance and design requirements for these filters can be found and referenced in Part 4 (attachments). If none of the pre-approved filters meet the performance or design requirements for a particular application, use this specification in its template format to procure a different filter.

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. ASME HEPA Filters and Case (Housings for these per Section 15885)
2. Auxiliary HEPA Filters and Housings
3. Non-HEPA Filters and Housings

B. Related Sections

1. Section 15885, HEPA Filtration System

C. Applicability

1. This specification applies to filters for use in air and gas streams with a 250°F maximum continuous temperature.

2. This specification applies to the procurement of filters for Department of Energy (DOE) facilities at Los Alamos National Laboratory.

1.2 REFERENCES

A. General

1. The standards and specifications designated below are a part of this specification to the extent specified herein. The most current revisions of standards and specifications apply. In the event of a conflict between provisions of this specification and provisions of the referenced documents, the text of this specification takes precedence.

B. American Society of Mechanical Engineers (ASME)

1. ASME AG-1, section FC, HEPA Filters

2. ASME Boiler and Pressure Vessel Code

3. ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities

C. ASTM International (ASTM; formerly American Society for Testing and Materials)

1. ASTM A 240, Standard Specification for Heat Resisting Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

2. ASTM A 479, Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

3. ASTM B 16, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines

4. ASTM B 209, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate

5. ASTM E 84, Test Method of Surface Burning Characteristics of Building Materials

6. ASTM E 499, Standard Test Methods for Leaks Using the Mass Spectrometer Leak Detector in Detector Probe Mode

D. Institute of Environmental Sciences and Technology (IEST)

1. IEST-RP-CC001.3, HEPA and ULPA Filters

E. International Organization for Standardization

1. ISO 9001, Quality Management Systems Requirements

F. Department of Energy (DOE)

1. DOE-STD-3020, Specification for HEPA Filters Used by Contractors.

G. National Bureau of Standards

1. NBS PS-1, Construction and Industrial Plywood.

H. Underwriter Laboratories

1. UL-586, Standard for High Efficiency Particulate Air Filter Units.

I. Code of Federal Register

1. 10 CFR 830.122, Quality Assurance.

2. 40 CFR 261, Identification and Listing of Hazardous Waste.

1.3 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

A. Acceptance Test: Inspection and testing of a filter to verify certain characteristics or properties, which determine the acceptance or rejection of that filter.

B. Approved Test Aerosol: Particle-generating materials approved by DOE and used as test aerosols for performing testing of HEPA filters.

C. ASME HEPA Filters: Open faced, fire resistant, HEPA filters used in ventilation duct for use in nuclear air cleaning systems. These filters are specifically addressed in ASME AG-1, Section FC.

D. Auxiliary HEPA Filters: HEPA Filters that are not specifically addressed in ASME AG-1, section FC, such as sintered metal filters and round filters.

E. CMTR: Certified Material Test Report

F. CoC: Certificate of Conformance

G. EPA: Environmental Protection Agency

H. Filter Test Facility (FTF): A facility established by the DOE specifically to conduct performance tests and quality assurance inspections of HEPA filters.

I. High Efficiency Particulate Air (HEPA) Filter: A filter with a particle removal efficiency of at least 99.97% for 0.3 micrometers particles of an approved aerosol test.

J. Nominal Air Flow Rating: The flow rate which HEPA filters are identified by the manufacturer and confirmed at the FTF.

K. Non-HEPA Filters: Filters that do not meet the efficiency requirements of a HEPA filter.

L. NPT: National Pipe Thread

M. Nuclear Facility: A DOE facility in which radioactive materials are produced or handled to the degree that environmental protection is required.

N. Penetration: The downstream test aerosol concentration, expressed as a percentage of the upstream test aerosol concentration.

O. PTFE: Polytetrafluoroethylene

P. QA: Quality Assurance

Q. Qualification Test: A test, often destructive, of a prototype or randomly selected production filter to establish its capability to meet certain functional and specification requirements. The results of the test are considered to be typical of individual items or model number, which are of the same design and are manufactured by the same process.

R. SST: Stainless steel

S. VCR: Crawford Fitting Company's trade name for Cajon metal gasket face seal fitting.

1.4 SYSTEM DESCRIPTION

A. Design Requirements

1. ASME HEPA Filters

a. Design in accordance to ASME AG-1, article FC-4000, Design.

b. Type [A, B, or C]

c. Number Designation: [1 - 9]

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ASME HEPA Filters – Type and number designation are defined in ASME AG-1, Section FC
Type A – Folded filter media with corrugated separator/supports
Type B – minipleat medium with glass fiber or noncombustible thread separators
Type C – continuous corrugated filter media folded without separators
1 – size: 8”x8”x3 1/16”, min. rated air flow: 25 scfm
2 – size: 8”x8”x5 7/8”, min. rated air flow: 50 scfm
3 – size: 12”x12”x5 7/8”, min. rated air flow: 125 scfm
4 – size: 24”x24”x5 7/8”, min. rated air flow: 500 scfm
5 – size: 24”x24”x11 1/2”, min. rated air flow: 1000 scfm
6 – size: 24”x24”x11 1/2”, min. rated air flow: 1250 scfm
7 – size: 24”x24”x11 1/2”, min. rated air flow: 1500 scfm
8 – size: 24”x24”x11 1/2”, min. rated air flow: 2000 scfm
9 – size: 12”x12”x11 1/2”, min. rated air flow: 250 scfm

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2. Auxiliary HEPA Filters

a. Particle removal efficiency of 99.97% for 0.3 micrometers or better of an approved test aerosol.

b. Withstand a minimum pressure differential of [10] in. of water.

c. Pressure differential of less than [X] in. of water at a flow rate of [X] scfm.

d. [specify leak tightness of housing].

e. [specify end connections].

f. [specify overall dimensions].

****
Auxiliary HEPA filters

Edit Design Requirements as necessary and add any additional criteria. Be sure to specify the following:

- Pressure differential at specified flowrate
- Housing leak tightness
- End fittings
- Overall dimensions

Part 4 is an appendix of filters commonly used at LANL and their specific specifications. If using a filter from the appendices, transfer data from appendix to the correct section or refer user to appendix for design requirements.

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3. Non-HEPA Filters

   a. [specify filtration level] micron filtration.

   b. Withstand a minimum pressure differential of [10] in. of water.

   c. Pressure differential of less than [X] in. of water at a flow rate of [X] scfm.

   d. [specify leak tightness of housing].

   e. [specify end connections].

   f. [specify overall dimensions].

****

Non-HEPA filters

Edit Design Requirements as necessary and add any additional criteria. Be sure to specify the following:

- Filtration level
- Pressure differential at specified flowrate
- Housing leak tightness
- End fittings
- Overall dimensions

Part 4 is an appendix of filters commonly used at LANL and their specific specifications. If using a filter from the appendices, transfer data from appendix to the correct section or refer user to appendix for design requirements.

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1.5 SUBMITTALS

A. Submit the following in accordance with Section 01330, Submittal Procedures:

1. ASME HEPA Filters

   a. Certification documentation from an independent FTF indicating that HEPA filter model(s) have been successfully qualified in accordance with ASME AG-1 Section FC and Section 1.6.

b. COC that is signed or otherwise authenticated by responsible managers within the supplying organization and that certifies the conformance of end-items to order requirements. The Certificate of Conformance must include:

- Copy of the HEPA filter manufacturer's QA plan identifying procurement, fabrication, test & inspection, material traceability and non-conformity controls for approval
- Statement that the products are constructed in accordance with the requirements in ASME AG-1, Section FC, manufacturer's QA plan and Section 1.6.
- Qualification and Acceptance Test reports.
- Purchased item identified by model number.
- Purchase Order (PO) number.
- Any approved changes, waivers, or deviations from this specification.

c. Installation Instructions

d. Warranty documentation - guarantee against failure in proper use or operation caused by defective materials and/or workmanship for a period of 1 year from the date of acceptance.

e. List and label each filter per ASME AG-1, Article FC-9100.

2. Auxiliary HEPA Filters

a. Certificate of Conformance that is signed or otherwise authenticated by responsible managers within the supplying organization and that certifies the conformance of end-items to order requirements. The Certificate of Conformance must include:

- Copy of the HEPA filter manufacturer's QA plan identifying procurement, fabrication, test & inspection, material traceability and non-conformity controls for approval.
- Certification that filters and filter media have been designed, manufactured and constructed in accordance with manufacturer's QA plan and Section 1.6.
- Certification documentation showing that the filter meets the design requirements of Section 1.4, including Qualification and Acceptance reports, and material requirements of Section 2.2. Examples of such documents include: supplier performance test information, inspection reports, justification for design integrity, drawings, etc.
- Certification that all custom-built filter housings are fabricated and leak tested to meet the requirements of this specification. Examples of such document include: personnel certification for welding, inspection and leak testing, leak test procedures and reports.

- Purchased item identified by model number.
- Statement that the filter housing meets the leak test requirements in section 1.4.
- Purchase Order (PO) number.
- Any approved changes, waivers, or deviations from this specification.

b. Installation Instructions

c. Warranty documentation - guarantee against failure in proper use or operation caused by defective materials and/or workmanship for a period of 1 year from the date of acceptance.

d. List and label each filter per UL-586.

3. Non-HEPA Filters

a. Certificate of Conformance that is signed or otherwise authenticated by responsible managers within the supplying organization and that certifies the conformance of end-items to order requirements. The Certificate of Conformance must include:

- Copy of the filter manufacturer's QA plan identifying procurement, fabrication, test & inspection, material traceability and non-conformity controls for approval.
- Certification that filters and filter media have been designed, manufactured and constructed in accordance with manufacturer's QA plan and Section 1.6.
- Certification documentation showing that the filter meets the design requirements of Section 1.4, including Qualification and Acceptance Test reports, and material requirements of Section 2.2. Examples of such documents include: supplier performance test information, inspection reports, justification for design integrity, drawings, etc.
- Certification that any custom built filter housing was fabricated and leak tested to meet the requirements of this specification. Examples of such document include: personnel certification for welding, inspection and leak testing, leak test procedures and reports.
- Purchased item identified by model number
- Statement that the filter housing meets the leak test requirements in section 1.4
- Purchase Order (PO) number
- Any approved changes, waivers, or deviations from this specification

b. Installation Instructions

c. Warranty documentation - guarantee against failure in proper use or operation caused by defective materials and/or workmanship for a period of 1 year from the date of acceptance.

d. Label each filter with the following:

- Manufacturer's name or symbol
- Filtration size
- Flow direction

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Submittal of QA plan may not be necessary if filter manufacturer is on the LANL approved vendor list. Consider requiring CMTRs for custom fabricated filter housings.

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1.6 QUALITY ASSURANCE AND TESTING

A. ASME HEPA Filters

1. Seller's Quality Assurance Requirements

a. Manufacture, inspect, test and ship under a quality assurance program meeting the applicable requirements of 10 CFR 830.122.

2. Seller's Qualification Testing requirements

a. Maintain all qualification certificates for filter models provided under this specification.

B. Auxiliary HEPA Filters

1. Seller's Quality Assurance Requirements

a. Develop, implement, and maintain an approved QA system (including program/plan, procedures, and process control documents) in accordance with 10 CFR 830.122. If the seller's QA plan is not in accordance with 10 CFR 830.122, then a LANL-approved QA plan based on appropriate industry consensus standards such as ISO 9001 is acceptable.

2. Seller's Qualification Testing requirements

a. Maintain all qualification certificates for filter models provided under this specification.

C. Non-HEPA Filters

1. Seller's Quality Assurance Requirements

a. Develop, implement, and maintain an approved QA system (including program/plan, procedures, and process control documents) in accordance with 10 CFR 830.122. If the seller's QA plan is not in accordance with 10 CFR 830.122, a LANL approved QA plan based on appropriate industry consensus standards, such as ISO 9001 is acceptable.

2. Seller's Qualification Testing requirements

a. Maintain all qualification certificates for filter models provided under this specification.

1.7 PACKAGING, SHIPPING AND STORAGE

A. Package, ship and store ASME HEPA filters per the requirements for level B items in accordance with ASME NQA-1 and:

1. Specify that filter cartons be placed on an oversized pallet and secured or crated to eliminate unit handling at carrier inter change points and avoid unnecessary damage.

2. Do not stack HEPA filters more than three high.

3. For large shipments, ship the entire shipment in a sealed dedicated trailer or rail car to provide an additional quality assurance of product shipping and handling.

4. Ship and store filters properly orientated, as indicated on shipping container.

5. Do not store filters for more than 10 years after manufacture date. If filter has been in storage for greater than 3 years, visually inspect gaskets for cracks, before installation.

B. Package, ship and store Auxiliary HEPA and Non-HEPA filters per the following requirements

1. Do not stack filters more than three high. It is acceptable to stack filters more than three high, if the individual filter does not exceed 24" in size.

2. Ship and store filters properly orientated, in accordance with manufacturer's recommendation.

3. Do not store filters for more than 10 years after manufacture date. If filter has been in storage for greater than 3 years, visually inspect filter unit, especially seals for damage, before installation.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Comply with Section 01630, Product Options and Substitutions.

2.2 MANUFACTURERS

A. ASME HEPA Filters

1. The following is a list of some of the manufacturers with nuclear grade HEPA filter products that may meet the requirements of this specification and ASME AG-1. However, these manufacturers are not exempt from any seller requirements including the submission of qualification certification for approval.

a. AAF International (American Air Filter)

b. Camfil Farr, Inc.

c. Flanders Filters, Inc.

B. Auxiliary HEPA Filters

1. The following is a list of some of the manufacturers. in addition to those above, with HEPA equivalent or better filters that may meet the requirements of this specification. However, these manufacturers are not exempt from any seller requirements including the submission of qualification certification for approval.

a. Pall

b. Mott Corporation

c. Nuclear Filter Technology

C. Non-HEPA Filters

1. The following is a list of some of the manufactures, in addition to those above, with non-HEPA filters that may meet the requirements of this specification. However, these manufacturers are not exempt from any seller requirements including the submission of qualification certification for approval.

a. Swagelok

b. PTI

2.3 MATERIALS OF CONSTRUCTION

A. General

1. The following are not acceptable materials of construction:

a. Particle board

b. Asbestos

c. Cadmium-coated metals

d. Any material that generates EPA regulated wastes as specified in 40 CFR 261.

B. Filter Media

1. ASME HEPA Filters

a. Manufacture 0.015 in. thick (minimum), silicate media in accordance with Article I-3000 of ASME AG-1, Appendix FC-1.

2. Auxiliary HEPA Filters

a. Silicate material

b. Sintered metal, such as stainless steel, nickel and Hasteloy.

c. Ceramic

d. PTFE

3. Non-HEPA Filters

a. Silicate material

b. Sintered metal, such as stainless steel, nickel and hasteloy.

c. Ceramic

d. PTFE

C. Case

1. ASME HEPA Filters

a. Type 304 or 316 stainless steel, minimum 14 gauge, conforming to ASTM A240.

b. Plywood, minimum 3/4 inch thick, conforming to minimum grade A-C, NBS PS-1 and flame spread classification of 25 or less when tested in accordance with ASTM E 84.

D. Housing

1. Auxiliary HEPA Filters

a. Type 300 series stainless steel, minimum 16 gauge, conforming to ASTM A240 or ASTM A479.

b. Aluminum, minimum 16 gauge, conforming to ASTM B209.

2. Non-HEPA Filters

a. Type 300 series stainless steel, minimum 16 gauge, conforming to ASTM A240 or ASTM A479.

b. Aluminum, minimum 16 gauge, conforming to ASTM B209.

c. Brass, minimum 16 gauge, conforming to ASTM B16.

E. Separators (if required)

1. Aluminum, minimum 0.0015 inch thickness, conforming to ASME AG-1, Article FC-3160.

F. Adhesives

1. Used to splice the media, fasten gaskets to filter frame, and seal the filter pack or faceguards to the frame

a. Self-extinguishing in accordance with the spot-flame test of ASME AG-1, Article FC-5160.

G. Gaskets and Seals

1. ASME HEPA Filters

a. Flat Gaskets – in accordance with DOE-STD-3020

b. Fluid Seals – in accordance with DOE-STD-3020

2. Auxiliary HEPA and Non-HEPA Filters

a. Neoprene

b. Metallic

c. PTFE

d. Viton

H. Faceguards (if required)

1. Provide in accordance with ASME AG-1, Article FC-3140.

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Author's note: ASME regulated filters are designed specifically for use in a nuclear facilities. For Auxiliary HEPA and Non-HEPA filters, consider filter environment when selecting acceptable materials. Example: PTFE may not be an acceptable material for a radiation environment. Also note, the listing of materials for Auxiliary HEPA and Non-HEPA filters is not a complete list of possible materials, others may be acceptable. Again, carefully consider the environment (corrosion, radiation, etc) in which the filter will be operating.

Part 4 is an appendix of filters commonly used at LANL and their specific specifications. If using a filter from the appendices, transfer data from appendix to the correct section or refer user to appendix for materials.

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2.4 FABRICATION

A. General

1. ASME HEPA Filters and case

a. Fabricate in accordance with ASME AG-1, Article FC-6000 and 10 CFR 830.122.

2. Auxiliary HEPA Filters and housing

a. Fabricate in accordance with manufacturer's approved QA plan.

b. Assemble filter from materials designated in Section 2.2.

c. Do not patch holes or tears in filter media.

d. Ensure that filter is free from foreign matter and damage.

e. Fabricate housing to [specify leak tightness].

f. Provide [specify end connections].

3. Non-HEPA Filters and housing

a. Fabricate in accordance with manufacturer's approved QA plan.

b. Assemble Filter from materials designated in Section 2.2.

c. Do not patch holes or tears in filter media.

d. Ensure that filter is free from foreign matter and damage.

e. Fabricate housing to [specify leak tightness].

f. Provide [specify end connections].

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Author's note: Add additional Fabrication requirements as necessary, such as welding. Be sure to specify leak tightness and end connections for Auxiliary and Non HEPA Filters.

Part 4 is an appendix of filters commonly used at LANL and their specific specifications. If using a filter from the appendices, transfer data from appendix to the correct section or refer user to appendix for additional fabrication requirements.

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2.5 SOURCE QUALITY CONTROL

A. Qualification and Acceptance Test Criteria

1. ASME HEPA Filters

a. Perform qualification testing of filters and filter media by an FTF in accordance with ASME AG-1, Article FC-5100.

b. Perform acceptance testing of filters and filter media by an FTF in accordance with ASME AG-1, Article FC-5100 for Penetration.

2. Auxiliary HEPA Filters

a. Perform Factory qualification testing in the following categories:

- Penetration – Test with DOE-Approved Test Aerosol or laser as described in IEST-RP-CC001.3. If penetration of 0.3 micrometers exceeds 0.03%, filter is not acceptable.

- Overpressure Resistance - Precondition filter according to ASME AG-1, Article FC-5140. Submit filter to a pressure differential of 10 +/- 0.2 in. of water for 60 minutes. Check for evidence of damage. Within 15 minutes of pressure differential test, and while still wet, test the filter for the required maximum penetration of 0.03% of 0.3 micrometers.

- Resistance to Fire and Heated Air – Expose to air heated to 700° F +/-50° F for 5 minutes. Perform penetration test to ensure that filter does not exceed 3.0% penetration. Subject filter to spot flame test. If filter shows evidence of sustained burning anywhere except on gasket, the filter is not acceptable.

- Resistance to Rough Handling – Shake filter for 15 minutes at 3/4-inch amplitude and 200 cycles per minute. Check for evidence of filter damage. Conduct test with filter boxed and proper orientation as determined by manufacturer. Perform penetration test after handling test to ensure penetration requirements are still met.

- Leak Testing – Perform helium leak test in accordance with ASTM E499. Perform bubble leak testing in accordance with ASME Boiler and Pressure Vessel Code, Section V, Article 10.

b. Perform factory acceptance testing in the following categories:

- Penetration – Test with DOE-Approved Test Aerosol or laser as described in IEST-RP-CC001.3. If penetration of 0.3 micrometers exceeds 0.03%, filter is not acceptable.

- Leak testing – Perform helium leak test in accordance with ASTM E499. Perform bubble leak testing in accordance with ASME Boiler and Pressure Vessel Code, Section V, Article 10.

3. Non-HEPA Filters

a. Perform Factory performance testing in the following categories:

- Penetration – Test with DOE-Approved Test Aerosol or laser as described in IEST-RP-CC001.3. If penetration of specified particle size exceeds [specify penetration], filter is not acceptable.

- Overpressure Resistance – Precondition filter according to ASME AG-1, Article FC-5140. Submit filter to a pressure differential of 10 +/- 0.2 in. of water for 60 minutes. Check for evidence of damage. Within 15 minutes of pressure differential test, and while still wet, test the filter for the required maximum penetration, listed in Section 1.4.

- Resistance to Fire and Heated Air – Expose to air heated to 700° F +/-50° F for 5 minutes. Perform penetration test to ensure that filter does not exceed [specify penetration, approximately 10 times the rated penetration]. Subject filter to spot flame test. If filter shows evidence of sustained burning anywhere except on gasket, the filter is not acceptable.

- Resistance to Rough Handling – Shake filter for 15 minutes at 3/4-inch amplitude and 200 cycles per minute. Check for evidence of filter damage. Conduct test with filter boxed and proper orientation as determined by manufacturer. Perform penetration test after handling test to ensure penetration requirements are still met.

- Leak Testing – Perform helium leak test in accordance with ASTM E499. Perform bubble leak testing in accordance with ASME Boiler and Pressure Vessel Code, Section V, Article 10.

b. Perform factory acceptance testing in the following categories:

- Penetration – Test with DOE-Approved Test Aerosol or laser as described in IEST-RP-CC001.3. If penetration of specified particle size exceeds [specify penetration], filter is not acceptable.

- Leak testing – Perform helium leak test in accordance with ASTM E499. Perform bubble leak testing in accordance with ASME Boiler and Pressure Vessel Code, Section V, Article 10.

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect all filters upon shipment receipt and before installation for visual damage such as cracks, tears in filter media or dents in housing. Inspect gaskets for cracking or other signs of degradation.

3.2 INSTALLATION

A. Install per manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. Test all filters after installation for penetration as outlined in section on Qualification and Acceptance Test Criteria above.

B. Replace all filters that fail field penetration test.

C. Notify Seller of filter rejections and re-evaluate the future procurement status of that manufacturer and/or model.

PART 4 ATTACHMENTS

4.1 AUXILIARY HEPA FILTER – 4" ROUND

4.2 AUXILIARY HEPA FILTER – NUCLEAR TECHNOLOGIES, INLINE

4.3 NON-HEPA FILTER – SWAGELOK, INLINE

4.4 NON-HEPA FILTER – SWAGELOK, TEE TYPE

END OF SECTION

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Do not delete the following reference information:

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FOR LANL USE ONLY

This project specification is based on LANL Master Construction Specification 15865 Rev. 0, dated December 5, 2002.

ATTACHMENT 4.1

Auxiliary HEPA Filter – 4" round

Design Requirements (section 1.4 A 2)

- Particle removal efficiency of 99.97% of 0.3 micrometers or better of an approved test aerosol
- Pressure differential of less than 1.5 in. of water at rated flow rate
- Housing is not leak tight in open end configuration as drawn
- ¾" x 1" IPS class 150, 304 SST NPT, male hex bushing on one end of filter housing, other end open
- Filter media dimensions: 3 3/4" dia. x 5 3/8"
- Housing dimensions: 4" +/- 1/16" diameter x 8 1/2" long, with fitting
- Airflow discharge through bushing

Materials (section 2.2 B-G)

- Filter media – continuous pleated sheet of waterproof glass (boron silicate microfiber)
- Housing – 304 SST, 16 gauge
- Separator – separatorless
- Adhesive – per DOE-STD-3020
- Gasket – none
- Faceguard – none

Fabrication (section 2.3)

- Seal discharge end of filter with flat cap with a full penetration groove weld all around.
- Weld hex with a full penetration fillet weld all around the center of the cap.
- Ensure welds have a uniform transition from the joined material into weld deposit.
- Ensure welds are free of undercutting and unfused overlap of the weld deposit.
- Hold the width of the finish weld layer of butt welds to a minimum and do not exceed the width of the weld grove by more than a 1/16".
- Fillet welds must be symmetric with respect to the components they join
- Provide CMTRs for housing material

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Author's note: This filter configuration can be modified with different end connections and/or both ends sealed. If the configuration is modified such that both ends are sealed, specify a leak tightness criteria.

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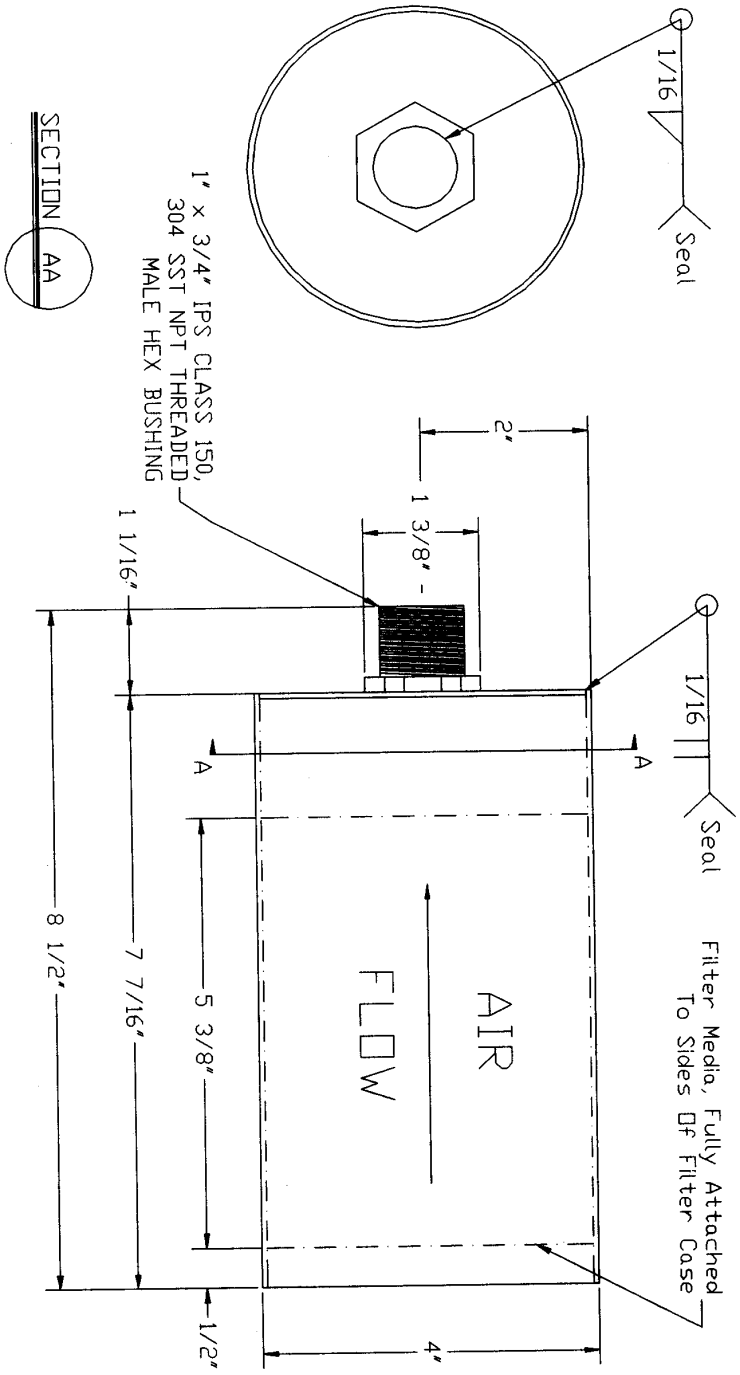
1/16
Seal
SECTION AA
1" x 3/4" IPS CLASS 150,
304 SST NPT THREADED
MALE HEX BUSHING
2"
1 3/8" -
1 1/16"
A
A
1/16
Seal
Filter Media, Fully Attached
To Sides Of Filter Case
AIR
FLOW
8 1/2"
7 7/16"
5 3/8"
1/2"
4"

ATTACHMENT 4.2

Auxiliary HEPA Filter – Nuclear Technologies, High Efficiency Inline Filter Assembly

Design Requirements (section 1.4 A 2)

- Particle removal efficiency of 99.97% of 0.3 micrometers or better of an approved test aerosol
- Pressure differential of less than 1.45 in. of water at 20 LPM
- Helium leak tight (<1E-06 cc/sec) housing
- ¼" [NPT or VCR] fittings
- Housing dimensions: 4"x.85"x6.4", with fitting

Materials (section 2.2 B-G)

- Filter media – 316 SST, sintered metal
- Housing – 304 SST
- Separator – separatorless
- Adhesive – none
- Gasket – none
- Faceguard – none

Fabrication (section 2.3)

- No additional requirements

ATTACHMENT 4.3

Non-HEPA Filter – Swagelok, "F" series, inline

Design Requirements (section 1.4 A 2)

- .5 micron filtration
- Pressure differential of less than [X psi] at [X scfm]
- Housing is not leak tight
- Fitting options:
  - 1/8" Swagelok tube fitting, female NPT
  - ¼" Swagelok tube fitting, male VCR , male and female NPT
  - 3/8" Swagelok tube fitting
  - ½" Swagelok tube fitting
  - 3 mm Swagelok tube fitting
  - 6 mm Swagelok tube fitting
- Housing dimensions: 9/16-1" dia. x 2.35-3.49" with fitting (varies by fittings)

Materials (section 2.2 B-G)

- Filter media – 316 SST, sintered metal
- Housing – 316 SST or brass
- Separator – separatorless
- Adhesive – none
- Gasket – silver plated 316 SST or aluminum
- Faceguard – none

Fabrication (section 2.3)

- No additional requirements

NOTE: Pressure resistance and flow rate vary based on operating conditions. Consult manufacturer's specifications.

ATTACHMENT 4.4

Non-HEPA Filter – Swagelok, "TF" series, Tee type

Design Requirements (section 1.4 A 2)

- .5 micron filtration
- Pressure differential of less than [X psi] at [X scfm]
- Housing is not leak tight
- Fitting options:
  - 1/8" Swagelok tube fitting, female NPT
  - ¼" Swagelok tube fitting, male and female NPT
  - 3/8" Swagelok tube fitting
  - ½" Swagelok tube fitting
  - 3 mm Swagelok tube fitting
  - 6 mm Swagelok tube fitting
  - See manufacturer's specification for more fitting options
- Housing dimensions: 9/16-1" dia. x 2.35-3.49" with fitting (varies by fittings)

Materials (section 2.2 B-G)

- Filter media – 316 SST, sintered metal
- Housing – 316 SST or brass
- Separator – separatorless
- Adhesive – none
- Gasket – silver plated 316 SST or aluminum
- Faceguard – none

Fabrication (section 2.3)

- No additional requirements

NOTE: Pressure resistance and flow rate vary based on operating conditions. Consult manufacturer's specifications.